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FOR: SYSTEM AND METHOD FOR DETERMINING THE CONNECTION STATE OF DEVICES CONNECTED TO A BUS

VERIFICATION OF A TRANSLATION

Assistant Commissioner for Patents
Washington, D.C. 20231
SIR :

I, the below named translator, hereby declare that:

1. My name and post office address are as stated below.

2. That I am knowledgeable in the English language and in the language of JP H11-191250, and I believe the attached English translation to be a true and complete translation of JP H11-191250.

3. The document for which the attached English translation is being submitted is a patent application on an invention entitled SYSTEM AND METHOD FOR DETERMINING THE CONNECTION STATE OF DEVICES CONNECTED TO A BUS.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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[Title of the Invention] Signal source detecting method, virtual output setting method, device control method, signal source setting method, device connection method, and program recoding medium

[Abstract]

[Object] When controlling a plurality of units connected by an IEEE1394 bus, it was necessary to respond to a multiplicity of and various types of commands to find the output destination of a signal depending on the connection state of the sub-units, which was low in convenience.

[Means to Solve the Problems] In a system consisting of D-VHS 100 and TV 200 connected to IEEE1394 bus 300, an output source can be detected immediately, regardless of the connection state of sub-units by using a command for detecting the signal input source of the connection destination.

[Claims]

[Claim 1] A signal source detecting method in a system constituted by connecting units including sub-units each having an input plug for signal

input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least two buses, for detecting the signal source of the unit,

wherein a specified unit on the bus sends out a detection command for detecting the output plug or the source plug as the signal source to other unit than the specified unit or a sub-unit of other unit than the specified unit, and

the unit or the sub-unit having received the command sends out a detection result to the specified unit.

[Claim 2] A virtual output setting method in a system constituted by connecting units each having an input plug for signal input, and an output plug for signal output, connected to a bus, for setting a virtual output by the unit,

wherein when a signal is detected in a specified channel on the bus,

all or part of the units receiving the signal sends a virtual output from the output plug to a specified channel on the bus although actually signal is not issued.

[Claim 3] A device control method using the virtual output setting method of claim 2,

wherein an arbitrary unit connected to the bus is issuing a signal, and

when a third unit connected to the bus recognizes the virtual output from a specified unit other than the arbitrary unit,

the third unit processes the signal issued from the arbitrary unit as a signal issued from the specified unit other than the arbitrary unit.

[Claim 4] The device control method of claim 3, wherein the specified unit other than the arbitrary unit is receiving a signal issued by the arbitrary unit.

[Claim 5] A signal source setting method in a system constituted by connecting units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least one bus, for specifying the signal source,

wherein the input plug or the source plug of the specified unit is specified as the signal source, on the output plug of a specified unit or the destination plug of a specified sub-unit on the bus.

[Claim 6] A signal source setting method in a system constituted by connecting units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least one bus, for specifying the signal source,

wherein the input plug of a specified unit or the source plug of a specified sub- unit on the bus is specified as the signal source, on the output plug or the destination plug of the specified unit.

[Claim 7] A device connection method having units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least two buses,

wherein before connecting a plurality of specified units on the bus, in each one of the plurality of specified units,

the input plug of a unit and the destination plug of a sub-unit in the unit are connected, and

the output plug of a unit and the source plug of a sub-unit in the unit are connected.

[Claim 8] The device connection method of claim 8, wherein the signal source setting method of claim 6 or 7 is used in connection between the plurality of units mutually and/or between the unit and a sub-unit of the unit.

[Claim 9] The signal source detection method of claim 1, wherein the bus is an IEEE1394 bus.

[Claim 10] The virtual output setting method of claim 2, wherein the bus is an IEEE1394 bus.

[Claim 11] The device control method of claim 3 or 4, wherein the bus is an IEEE1394 bus.

[Claim 12] The signal source setting method of claim 5 or 6, wherein the bus is an IEEE1394 bus.

[Claim 13] The device connection method of claim 7 or 8, wherein the bus is an IEEE1394 bus.

[Claim 14] A program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the signal source detecting method of claim 1 or 9.

[Claim 15] A program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the virtual output setting method of claim 2 or 10.

[Claim 16] A program recording medium recording a program for

allowing a computer to execute the steps of all or part of the operation of the device control method of any one of claims 3, 4 and 11.

[Claim 17] A program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the signal source setting method of any one of claims 5, 6 and 12.

[Claim 18] A program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the device connection method of any one of claims 7, 8 and 13.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a device control method for controlling a plurality of devices connected to a bus, and a signal source detection method, a signal source setting method, a virtual output setting method, and a program recording medium to be used therein.

[0002]

[Background Art]

Recently, in the background of popularity of digital video recorder and other digital technology in communication satellite broadcast, it has been attempted to control these digital appliances by connected to a same network.

[0003]

In such a network, an IEEE1394 interface is expected to be very useful as a versatile digital interface because of the following features:

signals can be transmitted between arbitrary devices regardless of form of their connection; live wires of cables used in connection can be inserted and removed; and both realtime data (isochronous data) such as AV signals, and non-realtime data (asynchronous data) such as device control commands can be transmitted simultaneously, so that it is easy to use for the personal computer (PC) and its related devices.

[0004]

Fig. 21 shows an example of configuration of a conventional system operating using the IEEE1394 interface. As shown in the diagram, devices such as STB 600, D-VHS 700, and TV 800 are connected to IEEE1394 bus 900 having a plurality of channels, respectively, and these devices constitute one system controllable as a logical unit. STB 600 has tuner 610, D-VHS 700 has video cassette recorder (VCR) 710, and TV 800 has monitor 810. Tuner 610, VCR 710, and monitor 810 are controlled as sub-units in the unit. The units and the sub-units have plugs for signal input and output, and in the unit, an input plug is set as digital input plug or external input plug, or digital asynchronous input plug, and an output plug is set as digital output plug or external input plug, or digital asynchronous output plug, respectively. In the sub-unit, an input plug is set as destination plug, and an output plug is set as source plug, respectively.

[0005]

The digital input and output plugs and the external input and output plugs can set the channels and operation by the control commands, and the destination and source plugs can set the operation or confirm the connection state by the control commands. Referring to Fig. 24 to Fig. 26, examples of

commands used in control and state confirmation of units and sub-units are explained.

[0006]

[Problems to be Solved by the Invention]

In the system constituted by connecting a plurality of devices by means of the IEEE1394 interface, when attempted to control input or the like of at least one device from each device, it is important to know which unit on the bus is connected to the single unit with what input and in which signal state (the channel input and output state).

[0007]

Fig. 22 (a) and (b) are diagrams of the internal constitution of D-VHS 700 shown in the unit of sub-units. In the diagram, the unit is -VHS 700, which includes sub-units in its inside such as tuners and video cassette recorders (VCR), and tuners 720a, 720b and VCR 710a, 710b may be connected as shown in Fig. 22 (a) and (b), respectively.

[0008]

In an example shown in Fig. 22 (a), digital output plug 701a of D-VHS 700, source plug 721a of tuner 720a, and source plug 711a of VCR 710a are connected in an exchangeable state directly. In an example shown in Fig. 22 (b), only source plug of VCR 710b is connected to digital output plug 701b of D-VHS 700b, and source plug 721b of tuner 720a is connected to destination plug 712b of VCR 710b. In this case, the output of tuner 720b is obtained always by way of VCR 710b.

[0009]

However, not limited to the examples shown in diagrams (a) and (b),

connection to digital output plug 701 of D-VHS 700 is automatically set by digital output plug 701, regardless of the connection state of sub-units, that is, tuner 720 and VCR 710.

[0010]

As mentioned above, each unit has sub-units in its inside, and the sub-units such as tuner 720 and VCR 710 individually receive and send out signals, and it is necessary to know the signal is coming out from which one of the sub-units in each unit depending on the manner of system control.

[0011]

In such a case, to trace back the output source of the signal up to the sub-units, aside from the first connection command, to know the connection state between sub-units and the operation state, it is required to exchange commands as shown in Fig. 24 to Fig. 26, and hence it takes enormous time and labor in the control of the entire system.

[0012]

On the other hand, the IEEE1394 interface has its own restriction, that is, a plurality of units cannot send out signals to a same channel on the bus at the same time.

[0013]

In this case, in a system provided with units having a certain configuration, the system operation may satisfy the above state.

[0014]

In such circumstance, suppose a configuration in which each unit receives and sends signals and the device having a plurality of internal structures is operating. For example, D-VHS 750 shown in Fig. 23

incorporates two sub-units, VCR 710 and tuner 720, and suppose that D-VHS 10 is receiving signals from STB 600 connected to the IEEE1394 bus, or is recording by built-in tuner 610, and is further monitoring the recorded program by TV 800 which is other (second) device connected to the bus.

[0015]

In this case, to obtain a monitor output from D-VHS 750 by using a system by the IEEE1394, two methods have been known. That is,

1. TV 800 obtains a monitor output from D-VHS 750 by using other channel than the channel connected to STB 600, TV 800, and D-VHS 750 (for example, channel 1 shown in the diagram).

[0016]

2. By judging which one of source plug 721 of tuner 720 and input plug of D-VHS 750 (receiving the input of STB 600) is connected to destination plug 711 of VCR 710 as a sub-unit in D-VHS 750, in the former case, the monitor output is obtained by using other channel than the channel connected to STB 600, TV 800, and D-VHS 750 (for example, channel 1 shown in the diagram). In the latter case, TV 800 judges that VCR 750 is recording the signal of STB 600, and the actual monitor output is directly obtained from STB 600.

[0017]

However, these two methods have their own problems. In case 1, using two channels, two identical data are transmitted into one bus, and the circuit resources are wasted. Or enough band may not be assured and data may not be transmitted.

[0018]

Case 2 solves the problems of case 1, but to realize the procedure of case 2, the command issuing and confirmation process are complicated. These problems are more difficult, for example, when other sub-unit is connected between VCR 710 and tuner 720.

[0019]

The present invention is devised in the light of the above problems, and it is hence an object thereof to present a device control method capable of identifying and controlling the input source of a signal immediately, by omitting the labor of closing inspecting the internal connection state of devices connected to the bus, and efficiently realizing both identification of input and output state of signals and convenience in operation, and a virtual output setting method and a program recording medium.

[0020]

[Means to Solve the Problems]

To achieve the above object, a first aspect of the present invention (corresponding to claim 1) is a signal source detecting method in a system constituted by connecting units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least two buses, for detecting the signal source of the unit, in which a specified unit on the bus sends out a detection command for detecting the output plug or the source plug as the signal source to other unit than the specified unit or a sub-unit of other unit than the specified unit, and the unit or the sub-unit having received the command sends out a detection result to the specified unit.

[0021]

A second aspect of the present invention (corresponding to claim 2) is a virtual output setting method in a system constituted by connecting units each having an input plug for signal input, and an output plug for signal output, connected to a bus, for setting a virtual output by the unit, in which when a signal is detected in a specified channel on the bus, all or part of the units receiving the signal sends a virtual output from the output plug to a specified channel on the bus although actually signal is not issued.

[0022]

A third aspect of the present invention (corresponding to claim 3) is a device control method using the virtual output setting method of claim 2, in which an arbitrary unit connected to the bus is issuing a signal, and when a third unit connected to the bus recognizes the virtual output from a specified unit other than the arbitrary unit, the third unit processes the signal issued from the arbitrary unit as a signal issued from the specified unit other than the arbitrary unit.

[0023]

A fourth aspect of the present invention (corresponding to claim 5) is a signal source setting method in a system constituted by connecting units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least one bus, for specifying the signal source, in which the input plug or the source plug of the specified unit is specified as the signal source, on the output plug of a specified unit or the destination plug of a specified sub-unit on the bus.

[0024]

A fifth aspect of the present invention (corresponding to claim 6) is a signal source setting method in a system constituted by connecting units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least one bus, for specifying the signal source, in which the input plug of a specified unit or the source plug of a specified sub-unit on the bus is specified as the signal source, on the output plug the destination plug of the specified unit.

[0025]

A sixth aspect of the present invention (corresponding to claim 7) is a device connection method having units including sub-units each having an input plug for signal input, an output plug for signal output, a destination plug for signal input, and a source plug for signal output, connected to at least two buses, in which before connecting a plurality of specified units on the bus, in each one of the plurality of specified units, the input plug of a unit and the destination plug of a sub-unit in the unit are connected, and the output plug of a unit and the source plug of a sub-unit in the unit are connected.

[0026]

A seventh aspect of the present invention (corresponding to claim 14) is a program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the signal source detecting method of the first aspect of the present invention.

[0027]

An eighth aspect of the present invention (corresponding to claim 15) is a program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the virtual output setting method of the second aspect of the present invention.

[0028]

A ninth aspect of the present invention (corresponding to claim 16) is a program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the device control method of the third aspect of the present invention.

[0029]

A tenth aspect of the present invention (corresponding to claim 17) is a program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the signal source setting method of the fourth or fifth aspect of the present invention.

[0030]

An eleventh aspect of the present invention (corresponding to claim 18) is a program recording medium recording a program for allowing a computer to execute the steps of all or part of the operation of the device connection method of the sixth aspect of the present invention.

[0031]

[Description of the Preferred Embodiment]

Referring now to the drawings, preferred embodiments of the present invention are specifically described below.

(Preferred Embodiment 1)

Fig. 1 is a block diagram of a system operating by using the signal

source detection method of preferred embodiment 1 of the present invention. As shown in the diagram, devices such as D-VHS 100 and TV 200 are connected to IEEE1394 bus 300 having a plurality of channels, and these devices constitute one system controllable as a unit. D-VHS 100 includes video cassette recorder (VCR) 110, and TV 200 includes monitor 210. VCR 110 and monitor 210 are to be controlled as sub-units. In this system, a personal computer (PC) not shown in the diagram is connected to IEEE1394 bus 300 as a controller for controlling the system, and D-VHS 100 and TV 200 (and built-in sub-units) are controlled by this PC.

[0032]

Fig. 7, Fig. 8, Fig. 10, Fig. 11, Fig. 15, and Fig. 16 are diagrams showing the constitution of the commands used in the signal source detection method of the preferred embodiment.

[0033]

The operation of the system having such configuration is explained below, together with the explanation of the signal source detection method of preferred embodiment 1 of the present invention. In the following explanation, the devices are handled as units or sub-units.

[0034]

To begin with, suppose a broadcast-out connection is connected between D-VHS 10 and specified channel of IEEE1394 bus 300 (herein, channel 0 in the diagram), while a broadcast-in connection is connected between channel 0 of IEEE1394 bus 300 and TV 20.

[0035]

In this state, an AV signal issued from D-VHS 100 is sent out as

isochronous data to TV 200 by way of channel 0 of IEEE1394 bus 300, and the AV signal recorded in VCR (sub-unit) 110 is displayed in monitor (sub-unit) 21 as video (and audio).

[0036]

In such state of isochronous data transfer, the user of the system requests the PC not shown to acquire information about the connection state of devices and the device types on IEEE1394 bus 300, or the operation state of the devices, to D-VHS 100. This request is specifically entered from on input device such as a keyboard.

[0037]

When the demand of such request is issued, the PC inquires about location of the signal input source giving the input to the destination plug of monitor (sub-unit) 21 in TV 200, by way of route (A) in the diagram, by specifying the destination plug number by the command in Fig. 7.

[0038]

By this inquiry, monitor (sub-unit) 210 receives a reply that destination plug 211 is obtaining an input from digital input plug 201 of TV 200.

[0039]

Successively, when TV 200 is inquired about location of the signal input source giving the input to the digital input plug, by specifying the input plug number by the command in Fig. 15, TV 200 receives a reply that digital output plug 201 is obtaining an input from channel 0 transferring isochronous data, and when the information is obtained, channel 0 transferring isochronous data obtains a reply of receiving an input from

digital output plug 102 having D-VHS 100, as a response in Fig. 16. If not having the capacity of replying to the command, the PC investigates the external input plug of TV 200, and obtains the information of the entered channel numbers, and sends PLUG INFO command to all devices on the bus. When the device corresponding to the output of the inquired channel receives the command, it replies that it is sending the output and replies the number of the output plug to the PC. The above reply is transmitted through route (B) in the diagram.

[0040]

If the signal source is not digital input plug, but is, for example, an external output plug (BS antenna) by way of a built-in tuner of D-VHS, a response shown in Fig. 10 (a) is returned. At this time, by using external plug type (external plug input type) shown in the diagram, it is also possible to notice the type of the external input plug (or some device not having replying capacity).

[0041]

Further, in route (C) in the diagram, the PC inquires D-VHS 100 about location of input signal source giving an input to the digital output plug, by designating (plugging) the output plug by using the command in Fig. 7. As a result, from D-VHS 100, digital output plug 102 obtains a reply of receiving an input from source plug 112 having VCR (sub-unit) 110, as a response in Fig. 10 (b). At this time, when digital output plug 102 is connected to digital input plug 101 (or external input plug not shown) of D-VHS 100, and is receiving an input of a signal, it becomes a final input signal source, and inquiry continues until arriving at the source plug, digital

input plug or external input plug of other unit or sub-unit.

[0042]

By the series of operations above, when the source of the video signal being presently issued to monitor (sub-unit) 210 of TV 20 is located to be VCR 110 in D-VHS 100, this device information is transferred from the side of D-VHS 100 to the PC as a response to the command.

[0043]

The information of connection state obtained from each response transferred to the PC can be presented to the user. Not depending on a third-party device such as PC, a device connected to IEEE1394 bus 300 may be used as the source of inquiry. In this case, in the inquiring device, the inquiry into its own inside can be omitted. For example, when TV 200 is inquiring, the inquiry of signal source to monitor (sub-unit) 210 can be omitted.

[0044]

When TV 200 acquires the device information, it is superposed on the AV signal which is isochronous data, and is displayed in monitor (sub-unit) 210.

[0045]

In this operation, TV 200 and/or D-VHS 100 has one sub-unit each, but if possessing a plurality of sub-units, as far as disposed in route (A) or (B) in the diagram, each sub-unit is regarded as a mere signal route, the output location of the signal can be confirmed by one reply, up to digital input plug 201 in TV 200, or up to VCR 110 in D-VHS 100. Therefore, in the unit having a plurality of sub-units different in the method of connection, such as

D-VHS 700 (a, b) shown in Fig. 22, the signal source can be identified immediately.

[0046]

In this preferred embodiment, between TV 200 and D-VHS 100, it is explained that a broadcast connection is established, but a P-to-P connection may be established, and the device control method of the present preferred embodiment can be executed in either case.

[0047]

In the present preferred embodiment, the operation for requesting information acquisition is voluntarily executed by the user, but it may be executed automatically when the broadcast connection or the P-to-P connection is established between the units.

[0048]

Fig. 2 is a block diagram of a second example of the system operating by using the signal source detection method of the present preferred embodiment. In the diagram, same components or elements as in Fig. 1 are identified with same reference numerals. Set top box (STB) 400 is, like TV 200, is a unit controllable as a unit, being connected to IEEE1394 bus 300, and includes digital output plug 401 and external output plug 402, and also has tuner 411 controllable as a sub-unit. TV 200 has external input plug 202 aside from digital input plug 201. TV 200 and STB 400 are connected to IEEE1394 bus 300, and external input plug 202 and external output plug 402 are connected by way of analog video and audio cable 500.

[0049]

The operation of the system having such configuration is explained

below to illustrate the signal source detection method in the second example of preferred embodiment 1 of the present invention.

[0050]

First of all, an AV signal issued from STB 400 is transmitted as an analog signal between external input plug 202 and external output plug 402, and is sent out to TV 200, and the AV signal received in STB 400 from BS antenna 420 is displayed in monitor 210 as video (and audio), and on IEEE1394 bus 300, STB 400 and TV 200 are transmitting signals for controlling the unit or the sub-unit as asynchronous data.

[0051]

In the state of transmission of AV signals by the analog signals, the user requests acquisition of information about the device type or operation state to a PC as a controller not shown. This request is specifically made by an input device such as a keyboard.

[0052]

When a command for such request is sent out, in monitor sub-unit 210 in TV 200, the destination plug is specified by a command in Fig. 7, and the location of signal input source giving an input to this destination plug 211 is inquired.

[0053]

By this inquiry, from monitor (sub-unit) 210 destination plug 211 obtains a reply showing that the input is obtained from external input plug 202 of TV 200. This is shown that the signal source plug is "external" in the response in Fig. 8.

[0054]

In succession, the PC inquires from which the input is obtained in external input plug 202 of TV 200, by specifying "external" in the plug in the command in Fig. 15 to TV 200. At this time, if the connection correspondence of external input plug 202 has been preliminarily recorded in TV 200, STB 400 obtains a reply showing that external input plug 202 of TV 200 is receiving the input from external output plug 402, on the basis of this recording. This reply is transmitted through route (B) in the diagram by the response in Fig. 17.

[0055]

Next, in route (C) in the diagram, STB 400 is inquired about location of input signal source giving an input to external output plug 402 of STB 400, by specifying "external" in the plug in the command in Fig. 7. As a result, STB 400 sends a reply showing that external output plug 402 is receiving the input from external input plug 404 of STB 400, by way of source plug 412 and destination plug 410 of tuner 411, as response shown in Fig. 11 (b).

[0056]

Herein, further examples of configuration of STB 400 are shown in Fig.3 (a) and (b). In STB 400, tuner 410 operates to select the signal station or put through the input from outside, and as shown in Fig. 3 (a), when an external input plug further connected to a digital BS antenna is connected to destination plug 411a of tuner 410, as explained above, the final input signal source is external input plug 420 of STB 400. At this time, if the correspondence between external input plug 420 and digital BS antenna has been preliminarily given as information, the reply of "digital BS antenna" is obtained as the final input signal source.

[0057]

As shown in Fig. 3 (b), meanwhile, in a configuration in which destination plug 411b of tuner 410b is connected to digital input plug 422 of STB 400, the final input signal source is digital input plug 422 of STB 400.

[0058]

By the series of operations above, when the source of the video signal being presently issued to monitor 210 of TV 200 is located to be external input plug 404 (BS antenna 420) in STB 400, and this device information is transferred from the side of STB 400 to the PC as a response (asynchronous data) to the command on IEEE1394 bus 300.

[0059]

The information of connection state obtained from each response transferred to the PC can be presented to the user. Not depending on a third-party device such as PC, a device connected to IEEE1394 bus 300 may be used as the source of inquiry. In this case, in the inquiring device, the inquiry into its own inside can be omitted. For example, when TV 200 is inquiring, the inquiry of signal source to monitor (sub-unit) 210 can be omitted.

[0060]

When TV 200 acquires the device information, it is processed and superposed on the AV signal obtained from the external output plug, and is displayed in monitor 210.

[0061]

Thus, according to the second example of the present preferred embodiment, even if an analog cable is used in signal transmission, the

device can be controlled same as in the first example, by using IEEE1394 bus 300.

[0062]

In this preferred embodiment, between a unit and a sub-unit, it is explained that commands in Fig. 7, Fig. 8, Fig. 10, Fig. 11, Fig. 15, or Fig. 16 are exchanged, but the present invention is not limited to this explanation alone, and depending on the connection state and configuration of the system or between sub-units in the unit, the type of input plug and output plug of the unit, or the type of the signal handled by the plug, commands shown in Fig. 9, Fig. 12, Fig. 17, or Fig. 18 may be also used.

(Preferred Embodiment 2)

Fig. 4 is a block diagram of a system operating by using the virtual output setting method of preferred embodiment 2 of the present invention and the device control method using the same. As shown in the diagram, devices such as STB 400, D-VHS 100 and TV 200 are connected to IEEE1394 bus 300 having a plurality of channels, and these devices constitute one system controllable as a unit. STB 400 includes tuner 410, D-VHS 100 includes video cassette recorder (VCR) 110 and its built-in tuner 120, and TV 200 includes monitor 210. Tuner 410, VCR 110, built-in tuner 120 and monitor 210 can be controlled as sub-units. In this system, a personal computer (PC) not shown in the diagram is connected to IEEE1394 bus 300 as a controller for controlling the system, and STB 400, D-VHS 100 and TV 200 (and built-in sub-units) are controlled by this PC.

[0063]

Fig. 7, Fig. 8, Fig. 10, Fig. 15, and Fig. 16 are diagrams showing the

constitution of the commands used in the virtual output setting method of the present preferred embodiment.

[0064]

The operation of the system having such configuration is explained below, together with the explanation of the virtual output setting method of preferred embodiment 2 of the present invention and the device control method using the same. In the following explanation, the devices are handled as units or sub-units.

[0065]

To begin with, suppose a broadcast-out connection is connected between STB 400 and specified channel of IEEE1394 bus 300 (herein, channel 0 in the diagram), while a broadcast-in connection is connected between channel 0 of IEEE1394 bus 300 and D-VHS 100 and TV 200.

[0066]

In this state, an AV signal issued from STB 400 is sent out as isochronous data to D-VHS 100 and TV 200 by way of channel 0 of IEEE1394 bus 300, and TV 200 is displaying the AV signal received from BS antenna 420 in STB 400 (built-in tuner 410) in monitor 210 as video (and audio), and D-VHS 100 is recording the signal issued from STB 400 in VCR 1100 in the inside.

[0067]

In such state of isochronous data transfer, the user requests to monitor the signal state between TV 200, STB 400, and D-VHS 100. This request is issued, for example, from an input device such as a keyboard, to a PC or a controller not shown.

[0068]

When such command for request is issued, the PC specifies the destination plug number by the command in Fig. 7, to monitor (sub-unit) 210 in route (A) in the diagram, and the state of the destination plug is inquired.

[0069]

By this inquiry, destination plug 211 obtains a reply showing that the input is obtained from digital input plug 201 of TV 200, by the response in Fig. 8, from monitor (sub-unit) 210.

[0070]

Next, to TV 200, by specifying a Serial Bus iPCR (digital isochronous input plug) by the command in Fig. 15, the state of digital input plug is inquired, from TV 200, a reply is obtained showing that digital input plug 201 is receiving the input of isochronous data in channel 0 in IEEE1394 bus 300 from digital output plug 102 of D-VHS 100, by the response in Fig. 16.

[0071]

Actually, however, digital input plug 201 of TV 200 is obtaining an isochronous data output by way of channel 0 in IEEE1394 bus 300, from digital output plug 401 of STB 400. Therefore, it is a virtual output that TV 200 is recognizing that the output is obtained in channel 0 from digital output plug 102 of D-VHS 100. Accordingly, in the response in Fig. 16, the output state is expressed as a "virtual output" (10).

[0072]

Further, along with detection of the virtual output, the subsequent response is processed. That is, to D-VHS 100, by specifying the digital output program number by the command in Fig. 7, the state of the digital

output plug is inquired. By this inquiry, D-VHS 100 obtains a replying showing that digital output plug 102 is obtaining an isochronous data input from digital input plug 101 of D-VHS 100, and as the response of Fig. 10 (a), an output from the digital output plug is sent into "channel 0" of 1394 isochronous channel, showing that the output state is a "virtual output." These responses are sent by way of route (C) in the diagram.

[0073]

Supposing, in route (D) in the diagram, that a digital input plug number is specified to D-VHS 100 by the command in Fig. 7, when the state of digital input plug 101 is inquired, a reply is obtained from D-VHS 100, by the response in Fig. 8, that digital input plug 101 is receiving an input of isochronous data by way of channel 0 in IEEE1394 bus 300 from digital output plug 401 of STB 400.

[0074]

Further, through route (E) in the diagram, to STB 400, by specifying the digital output plug (oPCR) by the command in Fig. 7, the state of digital output plug 401 is inquired, from STB 400, the signal-source plug is set to be "external" by the response in Fig. 10 (a), and a reply is obtained showing that digital output plug 401 is obtaining an input from external input plug 404 of STB 400, by way of source plug 412 and destination plug 411 of tuner (sub-unit) 410.

[0075]

By this series of replies, by making use of the virtual output, TV 200 obtains the input from STB 400, as if it were sent through D-VHS 100.

[0076]

On the other hand, for instance, in D-VHS 100, by specifying the destination plug by the command in Fig. 7 to VCR (sub-unit) 110, the state of the destination plug is inquired, and corresponding to it, from VCR (sub-unit) 110, by setting iPCR by the response in Fig. 8, a reply is obtained, showing that destination plug 111 is receiving an isochronous data input from digital input plug 101 of D-VHS 100. From this response, it is known that D-VHS 100 is recording the input from STB 400.

[0077]

Summing up the operations above, TV 200 obtains the input from STB 400 by way of D-VHS 100, and D-VHS 100 is recording the input from STB 400, and upon completion of the series of responses, the PC assumes that TV 200 is monitoring the signal of the STB recorded by D-VHS 100.

[0078]

The information of the state obtained by the individual responses transferred to the PC can be presented to the user. Not depending on a third-party device such as PC, a device connected to IEEE1394 bus 300 may be used as the source of inquiry. In this case, in the inquiring device, the inquiry into its own inside can be omitted. For example, when TV 200 is inquiring, the inquiry of signal source to monitor (sub-unit) 210 can be omitted.

[0079]

As a result, at the TV 200 side, the source of the video signal sent out to monitor 210 is regarded to be STB 400, and it is also regarded as a monitor signal from D-VHS 100, and the information of this meaning is superposed on the AV signal or isochronous data, and can be displayed in monitor 210.

[0080]

In this preferred embodiment, the operation for input changeover request is voluntarily executed by the user, but it may be executed automatically when the broadcast connection or the P-to-P connection is established between the units.

[0081]

In the present preferred embodiment, it is shown that the commands in Fig. 7, Fig. 8, Fig. 10, Fig. 15, Fig. 16 are exchanged, but the present invention is not limited to this explanation alone, and depending on the connection state and configuration of the system or between sub-units in the unit, the type of input plug and output plug of the unit, or the type of the signal handled by the plug, commands shown in Fig. 9, Fig. 11, Fig. 12, Fig. 17, or Fig. 18 may be also used.

(Preferred Embodiment 3)

Fig. 5 is a block diagram of a system operating by using the signal source setting method of preferred embodiment 3 of the present invention and the device connection method using the same. As shown in the diagram, devices such as D-VHS 100 and TV 200 are connected to IEEE1394 bus 300 having a plurality of channels, and these devices constitute one system controllable as a unit. D-VHS 100 includes video cassette recorder (VCR) 110, and TV 200 includes monitor 210. VCR 110 and monitor 210 are controlled as sub-units. The D-VHS 100 side has digital output plugs 102a and 102b, and the TV 200 side has digital output plugs 201a, 201b and 201c, and each unit has a plurality of digital input plugs or output plugs, and these digital input and output plugs can be mutually identified on the system. In

this system, a personal computer (PC) not shown in the diagram is connected to IEEE1394 bus 300 as a controller for controlling the system, and D-VHS 100 and TV 200 (and built-in sub-units) are controlled by this PC.

[0082]

Fig. 13 is a diagram showing a configuration of commands used in the signal source setting method of the preferred embodiment.

[0083]

The operation of the system having such configuration is explained below, together with the explanation of the signal source setting method of preferred embodiment 3 of the present invention and the device connection method using the same. In the following explanation, the devices are handled as units or sub-units.

[0084]

The device control method of the preferred embodiment is to connect the units after connecting sub-units in each unit. The procedure is explained below.

[0085]

To begin with, the PC not shown, using the command in Fig. 13 (a), 1. requests to set the digital input plug of TV 200 as signal source in destination plug 211, to monitor (sub-unit) 210 of TV 200. At this time, the digital output plugs provided in TV 200 are three in total, that is, plug 201a, plug 201b, and plug 201c, but the plug to which the setting is requested may be specified or not specified. For example, when a specific digital input plug and a destination plug are connected permanently (in the case of permanent connection), if other plug is specified, the setting may not be established.

Accordingly, in this preferred embodiment, the plug is not specified, and the command receiving side is allowed to select a plug. In this case, suppose the setting is specified in digital input plug 201a.

[0086]

Successively, 2. D-VHS 100 is requested to set source plug 112 of VCR 110 of D-VHS 100 as signal source in digital output plug. In this case, too, same as in the case of digital input plug of TV 200, it is not specified which one of the plurality of digital output plugs 102a, 102b should be set. In the present case, suppose the setting is specified in digital output plug 102b. In this operation, the sequence of steps 1 and 2 may be exchanged.

[0087]

Finally, digital plug 201a of TV 200 is requested to connect digital output plug 102b of D-VHS 100, and the both are connected.

[0088]

Thus, according to the device control method of the preferred embodiment, the units are connected after the sub-units are connected in each unit, and setting of a unit having a plurality of input and output plugs is done efficiently.

[0089]

Meanwhile, in VCR (sub-unit) 110 of D-VHS 100, if other operating sub-units are present (for example, VCR, hard disk drive (HDD), etc.), when setting them as signal sources, by the command shown Fig. 13 (b), the sub-unit and the number of its source plug may be specified.

[0090]

The information of the state obtained by the individual setting

transferred to the PC can be presented to the user. Not depending on a third-party device such as PC, a device connected to IEEE 1394 bus 300 may be used for setting.

[0091]

In the present embodiment, it is shown that the commands in Fig. 13 are exchanged, but the present invention is not limited to this explanation alone, and depending on the connection state and configuration of the system or between sub-units in the unit, the type of input plug and output plug of the unit, or the type of signal handled by the plug, commands, shown in Fig. 4, Fig. 19, or Fig. 20 may be also used.

(Preferred Embodiment 4)

Fig. 6 is a block diagram of a system operating by using the virtual output setting method of preferred embodiment 4 of the present invention, and the device control method and signal source setting method using the same. In the diagram, same reference numerals as in Fig. 4 refer to same components or corresponding components, and the detailed description is omitted. In TV 200, tuner 220 receives signal inputs from BS antenna 230 by way of external input plug 202.

[0092]

Fig. 13 and Fig. 19 are diagrams showing configurations of command used in the virtual output setting method of the preferred mbodiment.

[0093]

The operation of the system having such configuration is explained below, together with the explanation of the virtual output setting method of preferred embodiment 4 of the present invention, and the device control

method and signal source setting method using the same. In the following explanation, the devices are handled as units or sub-units.

[0094]

To begin with, an AV signal issued from STB 400 is sent out as isochronous data to D-VHS 100 and TV 200 by way of channel 0 of IEEE1394 bus 300. In TV 200, the AV signal received in built-in tuner 220 from BS antenna 230 (issued from source plug 222 by tuner 220) is entered in destination plug 211, and video (and audio) is displayed in monitor 210. In D-VHS 100, on the other hand, VCR 110 is recording the signal issued from STB 400.

[0095]

In such state of transfer of isochronous data, the user is viewing the signal received in tuner 220 built in TV 200, but requests to monitor the signal recorded in D-VHS 100. This request is specifically sent to a PC not shown, from an input device such as a keyboard.

[0096]

By output of such command for request, the PC commands monitor (sub-unit) 210 to change over to obtain the input from digital input plug 201 of TV 200, by using the command in Fig. 13 (a), by way of route (A) in the diagram.

[0097]

Next, to TV 200, by using the command in Fig. 19, a request is sent to receive the input of isochronous data to be issued to channel 0 of IEEE1394 bus 300 from digital output plug 102 of D-VHS 100.

[0098]

Actually, however, there is no output from digital output plug of D-VHS 100, and digital input plug 102 of TV 200 obtains the same signal as recorded in D-VHS 100, that is, the isochronous data output by way of channel 0 in IEEE1394 bus 300 from digital output plug 401 of STB 400. Therefore, it is a virtual output that TV 200 is recognizing that the output is coming in channel 0 from digital output plug 102 of D-VHS 100.

[0099]

By response of such command, TV 200, utilizing the virtual output, can obtain the input from STB 400 as if it were coming through D-VHS 100.

[0100]

In the preferred embodiment, it is shown that the commands in Fig. 13 and Fig. 19 are exchanged, but the present invention is not limited to this explanation alone, and depending on the connection state and configuration of the system or between sub-units in the unit, the type of input plug and output plug of the unit, or the type of the signal handled by the plug, commands shown in Fig. 4 or Fig. 20 may be also used, for further depending on the configuration, commands used in other preferred embodiments may be also used.

[0101]

In any preferred embodiment of the present invention, the present invention is explained mainly about the signal source detection method, virtual output setting method, device control method, signal source setting method, and device connection method, and as the recording medium of the present invention, it is possible to use any recording medium storing a program for allowing a computer to execute all or part of the functions of

each means, or all or part of the steps thereof.

[0102]

[Advantage of the Invention]

As clear from the description herein, according to the present invention, by omitting the time and labor for closely investigating the internal connection state of the devices connected to the bus, the signal input source can be immediately identified and controlled, and both identification of signal input and output state and convenience in operation can be efficiently realized, and the present invention presents such excellent signal source detection method, virtual output setting method, device control method, signal source setting method, device connection method, and program recording medium.

[Brief Description of the Drawings]

Fig. 1 is a block diagram of configuration of a system operating by using a signal source detection method according to preferred embodiment 1 of the present invention.

Fig. 2 is a block diagram of configuration of a second example of the system operating by using the signal source detection method according to preferred embodiment 1 of the present invention.

Fig. 3 is a block diagram of configuration of STB in the system operating by using the signal source detection method according to preferred embodiment 1 of the present invention.

Fig. 4 is a block diagram of configuration of a system operating by using a virtual output setting method according to preferred embodiment 2 of the present invention and a device control method using the same.

Fig. 5 is a block diagram of configuration of a system operating by using a signal source setting method according to preferred embodiment 3 of the present invention and a device connection method using the same.

Fig. 6 is a block diagram of configuration of a system operating by using a virtual output setting method according to preferred embodiment 4 of the present invention, and a device control method and a signal source setting method using the same.

Fig. 7 is a diagram of configuration of commands used in the signal source detecting method of the present invention.

Fig. 8 is a diagram of configuration of responses used in the signal source detecting method of the present invention.

Fig. 9 is a diagram of configuration of responses used in the signal source detecting method of the present invention.

Fig. 10 is a diagram of configuration of responses used in the signal source detecting method of the present invention.

Fig. 11 is a diagram of configuration of responses used in the signal source detecting method of the present invention.

Fig. 12 is a diagram of configuration of responses used in the signal source detecting method of the present invention.

Fig. 13 (a) and (b) are diagrams of configuration of commands used in the signal source setting method of the present invention.

Fig. 14 (a) and (b) are diagrams of configuration of commands used in the signal source setting method of the present invention.

Fig. 15 is a diagram of configuration of commands used in the signal source detecting method of the present invention.

Fig. 16 is a diagram of configuration of commands used in the virtual output setting method of the present invention.

Fig. 17 is a diagram of configuration of commands used in the signal source detecting method of the present invention.

Fig. 18 is a diagram of configuration of commands used in the signal source detecting method of the present invention.

Fig. 19 is a diagram of configuration of commands used in the signal source setting method of the present invention.

Fig. 20 is a diagram of configuration of commands used in the signal source setting method of the present invention.

Fig. 21 is a system configuration diagram connected with a plurality of devices by IEEE1394 interface in a prior art.

Fig. 22 (a) and (b) are diagrams showing connection state examples of sub-units in the inside of STB.

Fig. 23 is a system configuration diagram connected with a plurality of devices by IEEE1394 interface in a prior art.

Fig. 24 is a command configuration diagram used in a unit or a sub-unit connected to IEEE1394 interface in a prior art.

Fig. 25 is a command configuration diagram used in a unit or a sub-unit connected to IEEE1394 interface in a prior art.

Fig. 26 is a command configuration diagram used in a unit or a sub-unit connected to IEEE1394 interface in a prior art.

[Reference Numerals]

100, 700, 700a, 700b, 750 D-VHS

101, 201, 201a, 201b, 201c, 422 Digital input plug

102, 102a, 102b, 401, 701a, 701b Digital output plug

110, 710, 710a, 710b VCR

111, 211, 221, 411, 411a, 411b, 710a, 710b, 711 Destination plug

112, 121, 232, 412, 712, 721, 721a, 721b Source plug

120, 220, 410, 610, 720, 720a, 720b Tuner

200, 800 TV

202, 403, 404, 420 External input plug

210, 810 Monitor

230, 420 BS antenna

300, 900 IEEE1394 bus

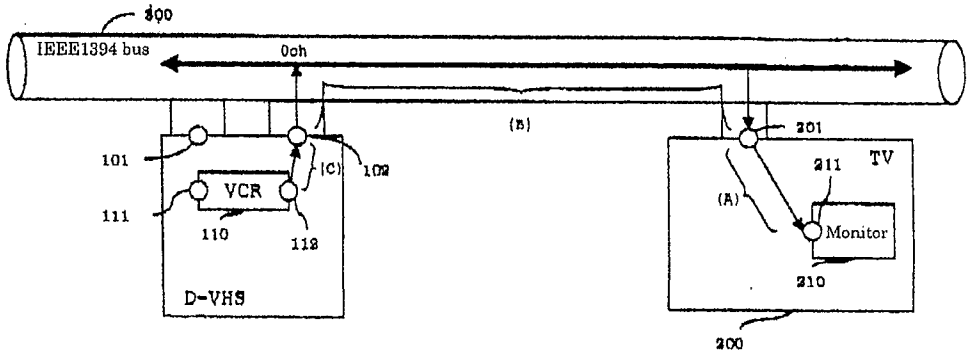
400, 600 STB

402 External output plug

421 CS antenna

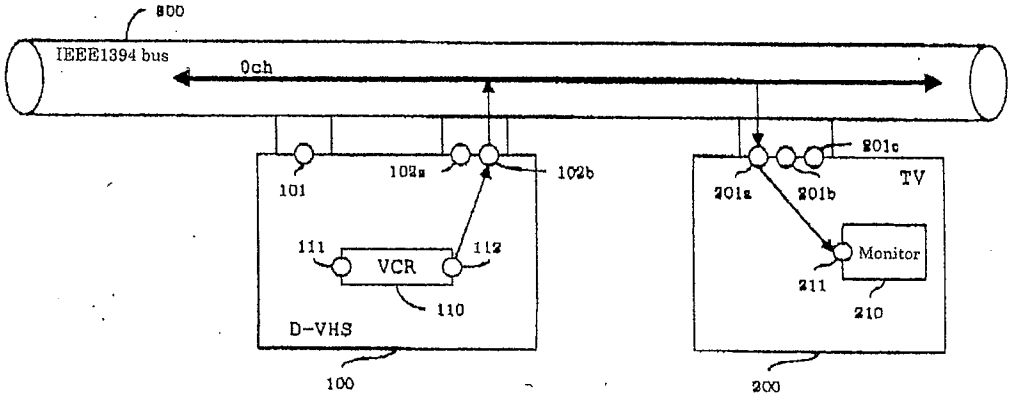
500 Analog video and audio signal cable

[Fig. 1]



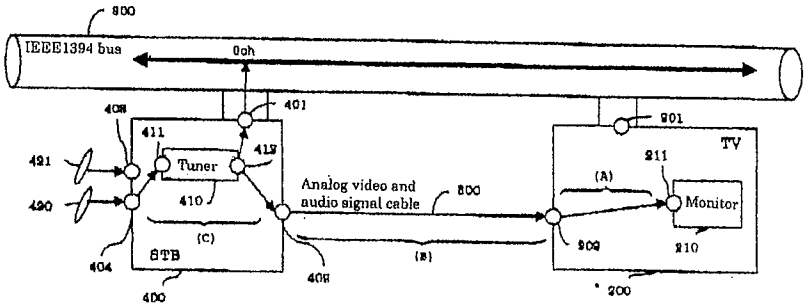
101	Digital input plug	200	TV
102	Digital output plug	201	Digital input plug
110	VCR	211	Destination plug
111	Destination plug	300	IEEE1394 bus
112	Source plug		

[Fig. 5]



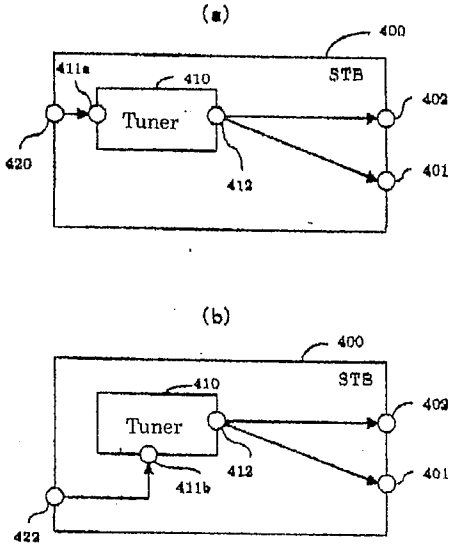
102a, 102b	Digital output plug
201a, 201b, 201c	Digital input plug

[Fig. 2]



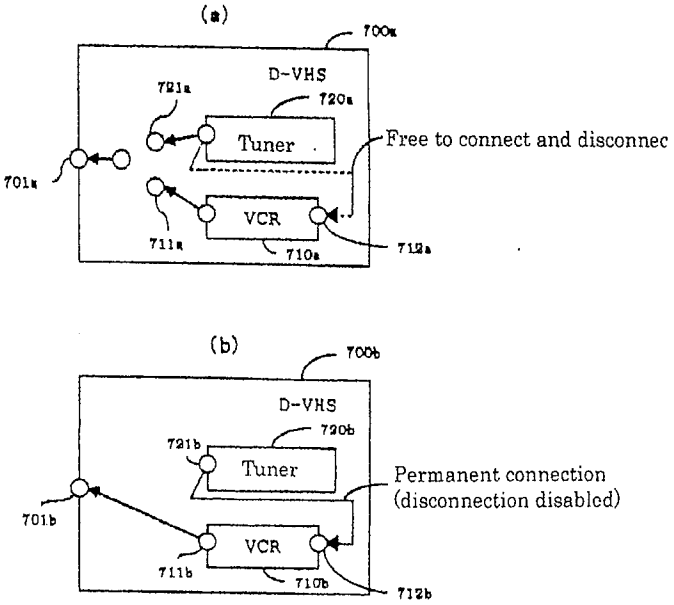
202 External input plug
400 STB
401 Digital output plug
402 External output plug
403 External input plug
404 External input plug
411 Destination plug
412 Source plug
420 BS antenna
421 CS antenna
500 Analog video and audio signal cable

[Fig. 3]



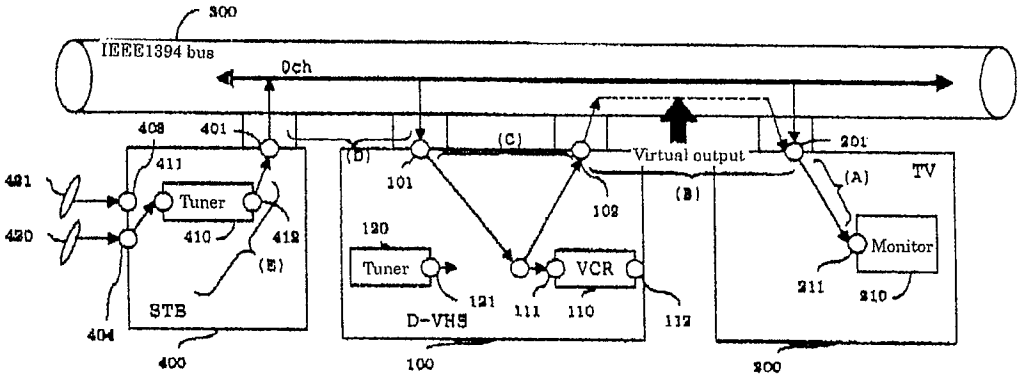
411a, 411b Destination plug

[Fig. 22]



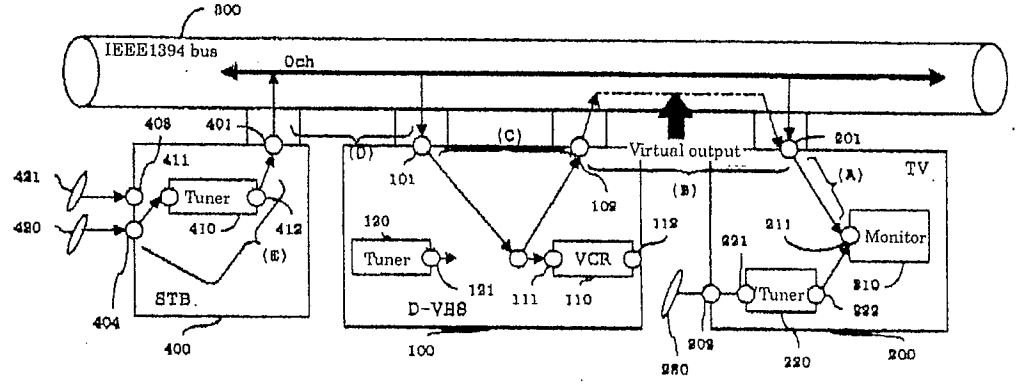
701a, 701b Digital output plug
711a, 711b Destination plug
712a, 712b Source plug
721a, 721b Source plug

[Fig. 4]



121 Source plug

[Fig. 6]



221 Destination plug
222 Source plug
230 BS antenna

Commands for inquiring signal source to unit or sub-unit

	msb							lsb
opcode	INTERNAL SIGNAL SOURCE(26_{16})							
operand[0]	plug							
operand[1]	signal_source_number							
operand[2]	FF_{16}							
operand[3]	FF_{16}							
operand[4]	FF_{16}							
operand[5]	FF_{16}							
operand[6]	FF_{16}							
operand[7]	FF_{16}							
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE status command

signal_source_number:

Designation of number of signal source
(To identify which number in the event of a plurality of signal sources)
(FF_{16} if not necessary to identify)

plug: Designation of plug type of inquiry destination

At the time of unit command:

value	plug
$0-1E_{16}$	Serial Bus OPCR[0]-OPCR[30]
$1F_{16}$ $-7E_{16}$	Reserved
$7F_{16}$	Reserved
$80_{16}-9E_{16}$	External output plug 0-30
$9F_{16}-99_{16}$	Reserved
$A0_{16}-BE_{16}$	Serial Bus Asychronous output plug[0]-[30]
BF_{16}	Reserved
$C0_{16}-FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Reserved

At the time of sub-unit command:

value	plug
$0-1E_{16}$	Destination plug 0-30
$1F_{16}$ $-FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Reserved

[Fig. 7]

Response from sub-unit if signal source to command inquiring signal source (to sub-unit) is input plug (unit)

When signal_source is input plug (unit)

	msb							lsb	
opcode	INTERNAL SIGNAL SOURCE (26_{16})								Same content as command
operand[0]	plug								
operand[1]	signal_source_number								
operand[2]	total_signal_source								Reply about signal source
operand[3]	FF_{16}								
operand[4]	signal_source_plug								
operand[5]	data type		11			external_input_type			
operand[6]	FF_{16}								Reply about output
operand[7]	FF_{16}								
operand[8]	FF_{16}								

INTERNAL_SIGNAL_SOURCE status response

total_signal_source:
Number of signal sources
(To reply the total number if signal sources are plural)

data_type: type of data of signal source

	data type
00	No information
01	Video
10	Audio
11	Audio/Video

signal_source_plug: plug type of signal source

	plug type
$0-1E_{16}$	Serial Bus 1PCR[0]-1PCR[30]
$1F_{16}-7E_{16}$	Reserved
$7F_{16}$	Reserved
$80_{16}-9E_{16}$	External input plug 0-30
$9F_{16}-99_{16}$	Reserved
$A0_{16}-BE_{16}$	Serial Bus Asynchronous input plug[0]-[30]
BF_{16}	Reserved
$C0_{16}-FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Reserved

external_input_type: type of external input plug

	external plug type
0000	analogue
0001	SCART
0010-0110	reserved
0111	antenna
1000	IEC958()coaxial
1001	IEC958(optical)
1010-1110	reserved
1111	(Serial Bus or Async)

[Fig. 8]

Response from sub-unit if signal source to command inquiring signal source (to sub-unit) is source plug (sub-unit)

When signal source is source plug (sub-unit)

	msb							lsb	
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})								Same content as command
operand[0]	plug								
operand[1]	signal_source_number								
operand[2]	total_signal_source								
operand[3]	subunit type						subunit ID		Reply about signal source
operand[4]	signal source plug(0-$1E_{16}$)								
operand[5]	data type	$3F_{16}$							
operand[6]	FF_{16}								Reply about output
operand[7]	FF_{16}								
operand[8]	FF_{16}								

signal_source_plug:

value	plug
0-$1E_{16}$	Source plug 0-30

subunit_type/subunit_ID:
Designation of sub-unit of signal source

[Fig. 9]

Response from unit inquiring about digital output plug to command inquiring signal source (to unit)

(a)

When signal source is input plug (unit)

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})							
operand[0]	plug($0\text{-}1E_{16}$)							
operand[1]	signal_source_number							
operand[2]	total_signal_source							
operand[3]	FF_{16}							
operand[4]	signal_source_plug							
operand[5]	data type		11		external plug type			
operand[6]	00	IEEE1394 isochronous channel						
operand[7]	output status				F_{16}			
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE status response

(b)

When signal source is source plug (sub-unit)

	msb							lsb	
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})								Same content as command
operand[0]	plug($0\text{-}1E_{16}$)								
operand[1]	signal_source_number								
operand[2]	total_signal_source								
operand[3]	subunit type							subunit ID	Reply about signal source
operand[4]	signal source plug								
operand[5]	data type	$3F_{16}$							
operand[6]	00	IEEE1394 isochronous channel							
operand[7]	output status							F_{16}	Reply about output
operand[8]	FF_{16}								

INTERNAL_SIGNAL_SOURCE status response

output_status: output status of "plug"

Value	output_status	IEEE1394 isochoroumous channel
0000	During output	channel number being issued from own device
0001	During virtual output	channel number being issued from other device
0010	No output	FF_{16}
0011-1111	reserved	reserved

[Fig. 10]

Response from unit inquiring about external output plug
to command inquiring signal source (to unit)

(a)

When signal source is input plug (unit)

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})							
operand[0]	plug(80_{16}-$9E_{16}$)							
operand[1]	signal_source_number							
operand[2]	total_signal_source							
operand[3]	FF_{16}							
operand[4]	signal_source_plug							
operand[5]	data type		11		external_input_type			
operand[6]	01		11		external_output_type			
operand[7]	external_output_status				F_{16}			
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE status response

(b)

When signal source is source plug (sub-unit)

	msb							lsb	
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})								Same content as command
operand[0]	plug(80_{16}-$9E_{16}$)								
operand[1]	signal_source_number								
operand[2]	total_signal_source								
operand[3]	FF_{16}								Reply about signal source
operand[4]	signal_source_plug								
operand[5]	data type		$3F_{16}$						
operand[6]	01		11		external_output_type				
operand[7]	external_output_status				F_{16}				Reply about output
operand[8]	FF_{16}								

INTERNAL_SIGNAL_SOURCE status response

external_output_status: output status
of "plug" (external plug: analog, etc.)

	external output status
0000	active
0001	reserved
0010	inactive
0011-1111	reserved

[Fig. 11]

Response from unit inquiring about asynchronous output plug
to command inquiring signal source (to unit)

(a)

When signal source is input plug (unit)

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE (26_{16})							
operand[0]	plug ($A0_{16}$-BE_{16})							
operand[1]	signal_source_number							
operand[2]	FF_{16}							
operand[3]	FF_{16}							
operand[4]	signal_source_plug							
operand[5]	data_type		11			external_input_type		
operand[6]	FF_{16}							
operand[7]	async_output_status				F_{16}			
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE status response

(b)

When signal source is source plug (sub-unit)

	msb							lsb	
opcode	INTERNAL_SIGNAL_SOURCE (26_{16})								Same content as command
operand[0]	plug ($A0_{16}$-BE_{16})								
operand[1]	signal_source_number								
operand[2]	FF_{16}								
operand[3]	subunit_type						subunit ID		Reply about signal source
operand[4]	signal_source_plug								
operand[5]	data_type		$3F_{16}$						
operand[6]	FF_{16}								
operand[7]	async_output_status				F_{16}				Reply about output
operand[8]	FF_{16}								

INTERNAL_SIGNAL_SOURCE status response

async_output_status: status
of "plug" (asynchronous plug)

	async output status
0000	connected
0001	reserved
0010	not connected
0011-1111	reserved

[Fig. 12]

Command for specifying signal source of sub-unit

(a)

When specifying input plug (unit) as signal source

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})							
operand[0]	plug							
operand[1]	signal_source_number							
operand[2]	FF_{16}							
operand[3]	FF_{16}							
operand[4]	signal_source_plug							
operand[5]	data type	$3F_{16}$						
operand[6]	FF_{16}							
operand[7]	FF_{16}							
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE control command

(b)

When specifying source plug (sub-unit) as signal source

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})							
operand[0]	plug							
operand[1]	signal_source_number							
operand[2]	FF_{16}							
operand[3]	subunit_type					subunit ID		
operand[4]	signal_source_plug							
operand[5]	data type	$3F_{16}$						
operand[6]	FF_{16}							
operand[7]	FF_{16}							
operand[8]	FF_{16}							

Reply about signal source

Reply about output

INTERNAL_SIGNAL_SOURCE control command

signal_source_plug:

value	plug type
$0-1E_{16}$	Serial Bus iPCR[0]-iPCR[30]
$1F_{16}-7E_{16}$	Reserved
$7F_{16}$	Any available Serial Bus plug iPCR[x]
$80_{16}-9E_{16}$	External input plug 0-30
$9F_{16}-99_{16}$	Reserved
$A0_{16}-BE_{16}$	Serial Bus Asynchronous input plug[0]-[30]
BF_{16}	Any available Serial Bus Asynchronous input plug
$C0_{16}-FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Any available External input plug

signal_source_plug:

value	plug
$0-1E_{16}$	Source plug 0-30
$1F_{16}-FC_{16}$	Reserved
FF_{16}	Any available source plug

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[Fig. 13]

Command for specifying signal source of unit

(a)

When specifying input plug (unit) as signal source

	msb							lsb
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})							
operand[0]	plug							
operand[1]	signal_source_number							
operand[2]	FF_{16}							
operand[3]	FF_{16}							
operand[4]	siganal_source_plug							
operand[5]	data type	$3F_{16}$						
operand[6]	FF_{16}							
operand[7]	FF_{16}							
operand[8]	FF_{16}							

INTERNAL_SIGNAL_SOURCE status response

(b)

When specifying source plug (sub-unit) as signal source

	msb							lsb	
opcode	INTERNAL_SIGNAL_SOURCE(26_{16})								
operand[0]	plug								
operand[1]	signal_source_number								
operand[2]	FF_{16}								Reply about signal source
operand[3]	subunit_type					subunit_ID			
operand[4]	signal_source_plug								
operand[5]	data type	$3F_{16}$							
operand[6]	FF_{16}								Reply about output
operand[7]	FF_{16}								
operand[8]	FF_{16}								

INTERNAL_SIGNAL_SOURCE status response

plug:

	plug type
$0-1E_{16}$	Serial Bus oPCR[0]-oPCR[30]
$1F_{16}$ $-7E_{16}$	Reserved
$7F_{16}$	Any available Serial Bus plug oPCR[x]
$80_{16}-9E_{16}$	External output plug 0-30
$9F_{16}-99_{16}$	Reserved
$A0_{16}-BE_{16}$	Serial Bus Asynchronous output plug[0]-[30]
BF_{16}	Any available serial Bus asynchronous output plug[x]
$C0_{16}-FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Any available external output plug

[Fig. 14]

[Fig. 15]

Command for inquiring signal source (output plug of unit) to unit (input plug)

	msb							lsb
opcode	EXTERNAL SIGNAL SOURCE(27_{16})							
operand[0]	plug							
operand[1]	FF_{16}							
operand[2]	FF_{16}							
operand[3]	FF_{16}							
operand[4]	FF_{16}							
operand[5]	FF_{16}							
operand[6]	FF_{16}							
operand[7]	FF_{16}							
operand[8]	FF_{16}							

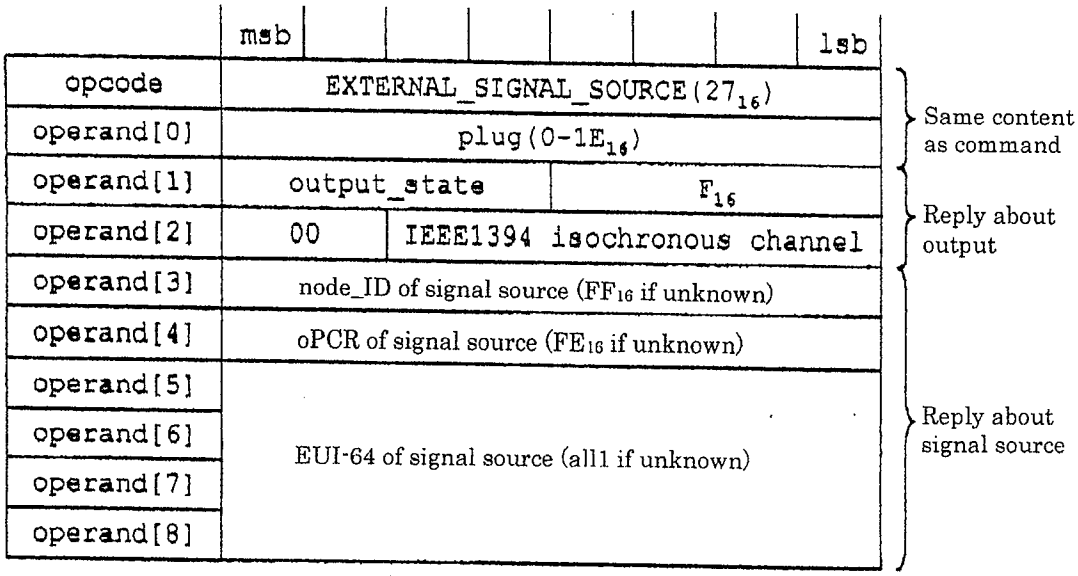
EXTERNAL_SIGNAL_SOURCE status command

plug:

value	plug
$0\text{-}1E_{16}$	Serial Bus iPCR[0]-iPCR[30]
$1F_{16}$ -$7E_{16}$	Reserved
$7F_{16}$	Reserved
80_{16}-$9E_{16}$	External input plug 0-30
$9F_{16}$-99_{16}	Reserved
$A0_{16}$-BE_{16}	Serial Bus Asynchronous input plug[0]-[30]
BF_{16}	Reserved
$C0\text{-}FD_{16}$	Reserved
FE_{16}	Reserved
FF_{16}	Reserved

[Fig. 16]

Response to command inquiring about signal source to digital output plug



	msb							lsb	
opcode	EXTERNAL_SIGNAL_SOURCE(27_{16})								Same content as command
operand[0]	plug($0\text{-}1E_{16}$)								
operand[1]	output_state							F_{16}	Reply about output
operand[2]	00		IEEE1394 isochronous channel						
operand[3]	node_ID of signal source (FF_{16} if unknown)								
operand[4]	oPCR of signal source (FE_{16} if unknown)								
operand[5]	EUI-64 of signal source (all1 if unknown)								Reply about signal source
operand[6]									
operand[7]									
operand[8]									

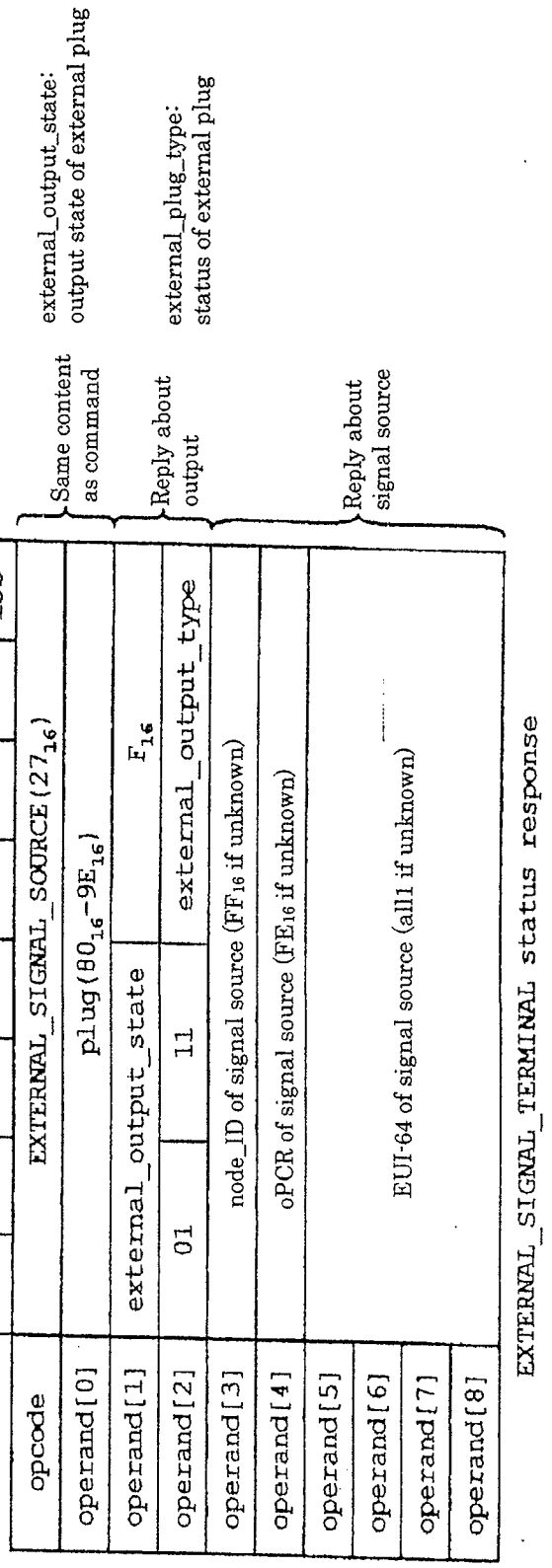
EXTERNAL_SIGNAL_TERMINAL status response

output_status: output status of signal source about "plug"

Value	output_status	IEEE1394 isochorounous channel
0000	During output	channel number being issued from own device
0001	During virtual output	channel number being issued from other device
0010	No output	FF_{16}
0011-1111	reserved	reserved

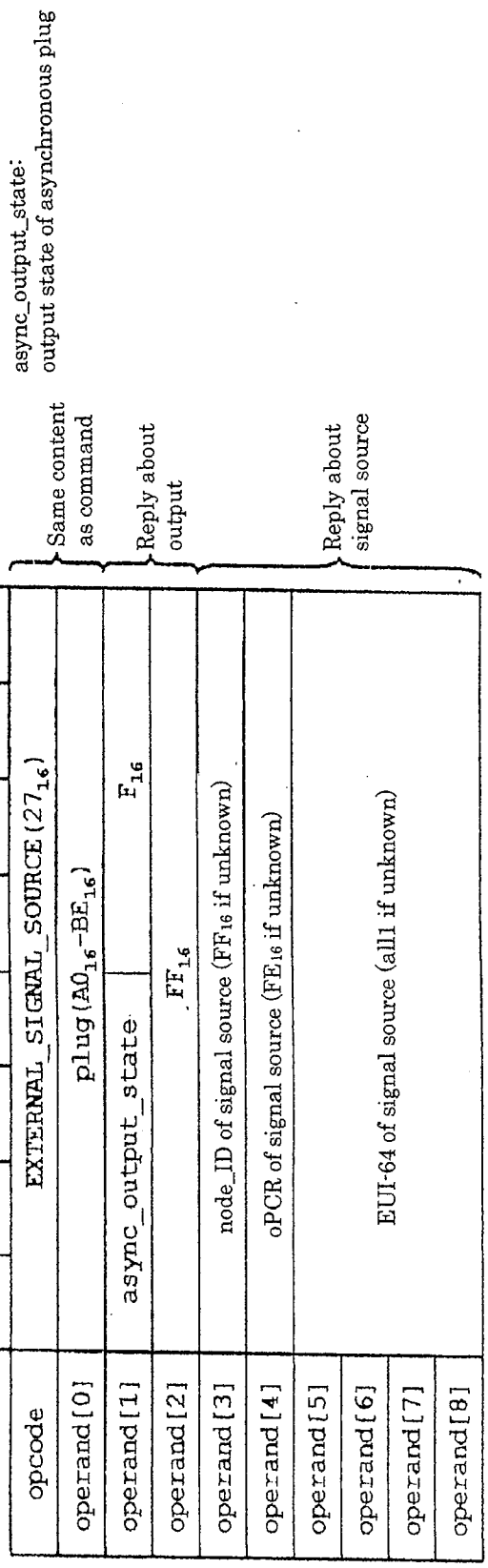
[Fig. 17]

Response to command inquiring about signal source to external input plug



[Fig. 18]

Response to command inquiring about signal source to asynchronous input plug



EXTERNAL_SIGNAL_TERMINAL status response

Command for setting digital output plug designated in
digital input plug as target unit of command as signal source

	msb							lsb
opcode	EXTERNAL_SIGNAL_SOURCE(27_{16})							
operand[0]	plug($0-1E_{16}$)							
operand[1]	output_state						F_{16}	
operand[2]	00		IEEE1394 isochronous channel					
operand[3]	node_ID of signal source (FF_{16} if unknown)							
operand[4]	oPCR of signal source (FE_{16} if unknown)							
operand[5]	EUI-64 of signal source (all1 if unknown)							
operand[6]								
operand[7]								
operand[8]								

EXTERNAL_SIGNAL_TERMINAL control command

Reply about output

Reply about signal source

plug: designation of plug

output_state: output state

IEEE1394 isochronous channel: input channel

Either node_ID or EUI-64 should be set.

[Fig. 19]

Command for setting external output plug designated in external input plug as target unit of command as signal source

	msb							lsb
opcode	EXTERNAL_SIGNAL_SOURCE(27_{16})							
operand[0]	plug(80_{16}-$9E_{16}$)							
operand[1]	external_output_state							F_{16}
operand[2]	01						11	external_output_type
operand[3]	node_ID of signal source (FF_{16} if unknown)							
operand[4]	oPCR of signal source (FE_{16} if unknown)							
operand[5]	EUI-64 of signal source (all1 if unknown)							
operand[6]								
operand[7]								
operand[8]								

EXTERNAL_SIGNAL_TERMINAL control command

Reply about output

Reply about signal source

plug: designation of plug

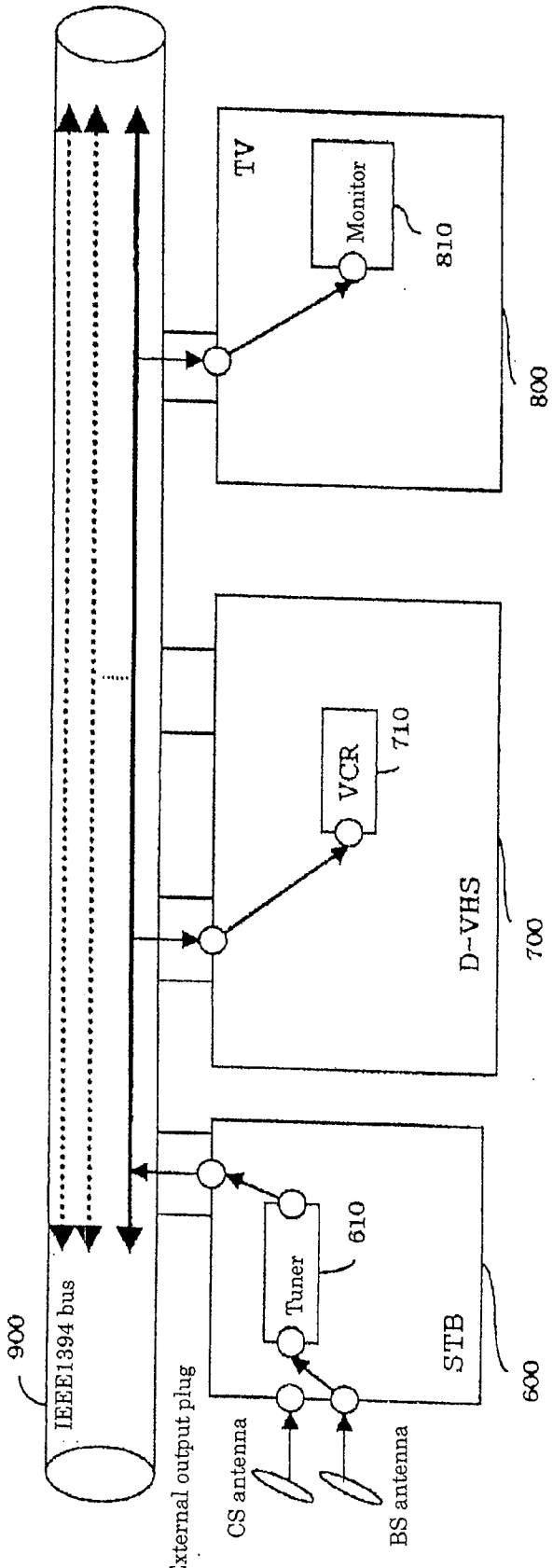
external_output_state: output state of external plug

external_output_type: type of external plug

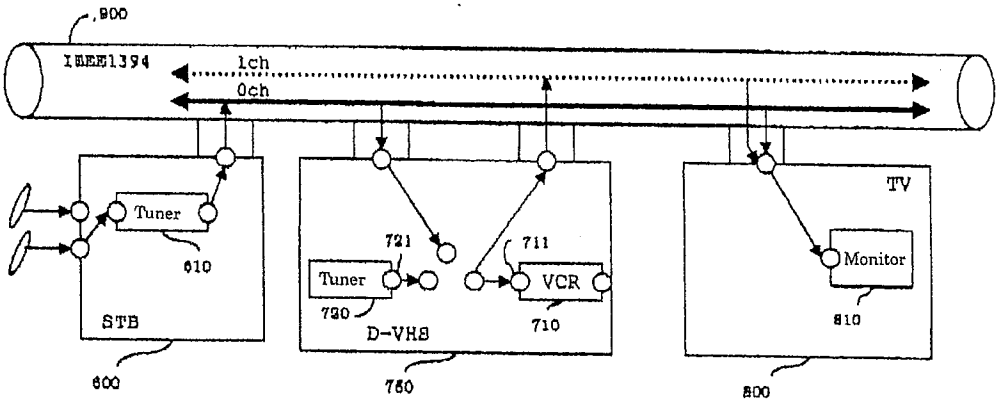
Either node_ID or EUI-64 should be set.

[Fig. 20]

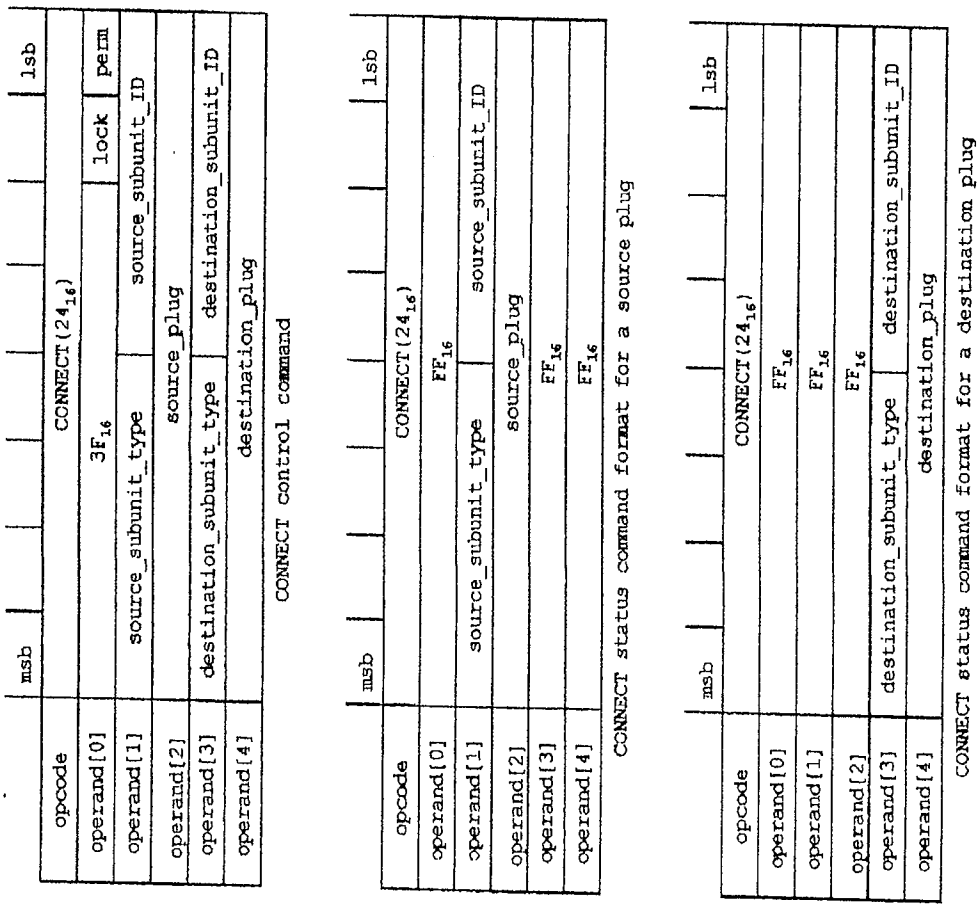
[Fig. 21]


900
IEEE1394 bus
External output plug
CS antenna
BS antenna
STB
600
Tuner
610
D-VHS
700
VCR
710
TV
800
Monitor
810

[Fig. 23]


900
IEEE1394
1ch
0ch
Tuner
610
STB
600
721
711
Tuner
730
D-VHS
VCR
710
750
TV
Monitor
810
800

[Fig. 24]


msb
lsb
opcode
CONNECT(24₁₆)
operand[0]
3F₁₆
lock
perm
operand[1]
source_subunit_type
source_subunit_ID
operand[2]
source_plug
operand[3]
destination_subunit_type
destination_subunit_ID
operand[4]
destination_plug
SU designation of input source
Source plug:
plug number of output
Destination plug:
plug number of input
CONNECT control command
operand[0]
FF₁₆
operand[1]
operand[2]
operand[3]
operand[4]
CONNECT status command format for a source plug
CONNECT status command format for a destination plug

	msb							lsb
opcode	CONNECT(24_{16})							
operand[0]	$3F_{16}$							
operand[1]	source_subunit_type=IE_{16}					source_subunit_ID=5_{16}		
operand[2]	extended_source_subunit_type							
operand[3]	extended_source_subunit_ID							
operand[4]	source_plug							
operand[5]	destination_subunit_type=IE_{16}					destination_subunit_ID=5_{16}		
operand[6]	extended_source_subunit_type							
operand[7]	extended_source_subunit_ID							
operand[8]	destination_plug							

CONNECT control command with extended soubunit_type and extended subunit_ID

subunit_type/subunit_ID:
Unit and SU designation of input source

Source plug:
plug number and type of output

Destination plug:
plug number and type of input

[Fig. 25]

value	source plug	destination plug
$0-1E_{16}$	Serial Bus iPCR[30]	Serial Bus oPCR[30]
$1F_{16}$ -$7E_{16}$	Reserved for future specification	Reserved for future specification
$7F_{16}$	Any available serial Bus plug iPCR[x]	Any available serial Bus plug oPCR[x]
$80_{16}-9E_{16}$	External input plug 0-30	External output plug 0-30
$9F_{16}-FC_{16}$	Reserved for future specification	Reserved for future specification
FD_{16}	Reserved for future specification	Multiple plugs
FE_{16}	Invalid	Invalid
FF_{16}	Any available External input plug	Any available External output plug

Serial Bus and external plug numbers

	msb							lsb
opcode	CONNECT AV(20_{16})							
operand[0]	Video_source_type		audio_source_type		video_dest_type		audio_dest_type	
operand[1]	video_source							
operand[2]	audio_source							
operand[3]	video_destination							
operand[4]	audio_destination							

CONNECT AV control command format for audio/video stream

audio_source:
input plug number of audio
video_source:
input plug number of video
audio_source:
input plug number of audio
video_destination:
output plug number of video
audio_destination:
output plug number of audio

Value	Source or destination type
0	Subunit
1	Ignore
2	Serial Bus or external plug
3	Reserved

Source or destination type

	msb							lsb
opcode	CONNECT AV(20_{16})							
operand[0]	F_{16}					video_dest_type	audio_dest_type	
operand[1]	FF_{16}							
operand[2]	FF_{16}							
operand[3]	video_destination							
operand[4]	audio_destination							

CONNECT AV status command format for audio/video stream

[Fig. 26]